Renewable and Sustainable Energy Reviews 14 (2010) 3116–3123

Contents lists available at ScienceDirect

Renewable and Sustainable Energy Reviews

journal homepage: www.elsevier.com/locate/rser

Wind power planning and permitting: Comparative perspectives from the Nordic countries☆

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ARTICLE INFO

Article history:
Received 13 May 2010
Accepted 13 July 2010

Keywords:
Wind power planning
Permitting process
Sweden
Denmark
Norway

ABSTRACT

The purpose of this paper is to analyze and compare some important institutional and legal preconditions for wind power development in three Nordic countries: Denmark, Norway and Sweden. In the paper a number of historical, institutional and policy-related differences across these countries are highlighted, but most attention is paid to the various territorial planning procedures. The analysis suggests that although public economic support to wind power is necessary to promote its diffusion in the electricity system, similar policy instruments – in terms of both size and design – can induce significantly different developments depending on the legal preconditions for the location and environmental assessment of windmills. The success and failure stories of technology support policies can thus not easily be transferred across country borders. An important conclusion is that in comparison to Sweden the physical planning systems in both Denmark and Norway provide greater scope for implementing a national wind power policy at the local level. For instance, the Danish planning system is vertically integrated, and involves a designation of areas for wind power purposes in the local plans, while the municipalities in Sweden must in some way assent to (i.e., plan for) the establishment of windmills at a certain location in order for the installation to actually take place. Compared to its competitors, wind power is one of the power-generating technologies that tend to have the most to lose from the uncertainties created by planning regulations that leave much discretion to local authorities.

Contents

1. Introduction

Investments in new renewable and carbon-free energy technologies face a number of economic, political and institutional hurdles, which in turn may motivate the use of public support schemes aimed at speeding up their diffusion process. Still, in order to design efficient policy instruments in this area, a proper understanding of the economic and institutional conditions that govern technology deployment in the energy sector is needed. So far much research attention has been paid to the design and the impacts of specific support schemes (certificate schemes, feed-in tariffs, etc.) (e.g. [1,2]), but fewer studies have addressed the

☆ Financial support from Elforsk (Market Design Program), the Swedish Environmental Protection Agency and the Swedish Energy Agency (Vindval research program) is gratefully acknowledged, as are valuable comments and help from Peter Fritz, Bengt Hanell, Carola Lindberg, Martin Luthander, Gabriel Michanek, Mats Nilsson, Hans Ohlsson, Lennart Sandebjer and Ulf Wikström. Any remaining errors, however, reside solely with the authors.
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doi:10.1016/j.rser.2010.07.008

decision-making structures, legal permitting procedures and planning systems that underpin renewable energy policy and practice [3]. Even though the costs of renewable energy technologies often have fallen far beyond expectations, these technologies have typically failed to meet expectations with respect to market penetration [4], suggesting that apart from cost disadvantages there exist additional legislative and institutional obstacles to renewable energy diffusion. Thus, renewable energy policies must address not only financial support but also institutional reforms, legal actions and public acceptance issues. The purpose of this paper is to analyze and compare environmental permitting and territorial planning procedures for wind power development in three Nordic countries: Denmark, Norway and Sweden.

With the globalization and deregulation of electricity markets worldwide increased attention is being paid to efficient market design and legal rules, and not least to the *enabling* – and thus not only the *protective* – role of plant permitting processes [5]. This dual role of permitting processes implies that it is important to assess whether the existing legislations in different countries enable investment in new power generation plants while at the same time avoiding significant negative impacts on public health and the environment. While electricity markets are becoming increasingly international in scope, licensing procedures and regulations are however still significantly influenced by national legislation and legal cultures. Significant differences in permitting and planning regulations among countries may negatively affect competition in well-integrated markets, and also lead to a cost-ineffective diffusion of new power plants.

The Danish, Norwegian and Swedish electricity systems are well-integrated and essentially form one common Nordic electricity market, but in this joint market both the legal and economic preconditions for investments in wind power and other generating plants differ. There already exists a significant literature on the rise of the Danish wind power industry, including comparisons with other countries such as Norway and Sweden (e.g. [3,6–8]). Still, previous studies typically stress the importance of the choice of policy support scheme for explaining the soar in Danish wind power investments during the 1990s. In Denmark a fixed feed-in tariff system has provided a long-term minimum price for electricity obtained from wind power, while the corresponding support systems used in Norway and Sweden have been less stable over time and offered comparatively weak economic incentives (see Section 2). The analysis in this paper, though, indicates that the strength and the design of the various public support schemes for wind power can only partly explain important inter-country differences in domestic wind power penetration rates. Even in the fairly politically homogenous Nordic countries the legal provisions governing the assessment of the environmental impacts of windmills and the planning procedures for their location differ in important ways.

A critical feature of the national regulations for wind power concerns the question of how formal political power is allocated between national, regional and local decision-makers. In legal systems that grant local authorities substantial discretion in influencing permitting processes, it may be difficult to gain public trust for – and in the end implement – projects that are deemed to be efficient from a national perspective. Such decentralized systems often induce both investors and national authorities to design strategies that aim at increasing local legitimacy for power projects (e.g., compensation mechanisms, facilitating local ownership, etc.).[1]

[1] There are many examples of how different countries have reformed their licensing procedures for new power plants during recent years. In many of these countries (e.g., Italy) the reforms have led to a more centralized process [5,9] or have implied the introduction of different strategies (e.g., compensation mechanisms) to increase local legitimacy (e.g., Spain).

Denmark, Norway and Sweden all have fairly decentralized planning systems, but as we will see they differ in the sense that it is more or less difficult for the local levels in the respective countries to override national energy policy goals. Similar policy support schemes (in terms of both size and design) can thus induce significantly different investment activities in wind power depending on the legal preconditions for these investments.

The territorial planning regulations are of course designed to promote an *overall* efficient use of resources in society, and to secure certain (more or less universal) legal rights. Their purpose is *not* to support the rapid diffusion of wind power *per se*. Nevertheless, it is useful to analyze these legal provisions from a wind power investor eye-view, not the least since such an approach permits us to highlight some of the (explicit and implicit) trade-offs made in the intersection between national energy policy goals and local priorities. The European Commission [10] has stressed the need to make the existing national systems for enabling investment in renewable electricity more efficient, not the least by improving policy stability and speeding up permitting processes. This requires, though, a clear understanding of the nature of wind power planning and permitting in the different Member States, and in this paper we illustrate that the – often subtle – legislative differences across the Nordic countries may matter a lot for wind power outcomes.

The paper proceeds as follows. In Section 2 we provide a brief historical assessment of wind power development in Denmark, Norway and Sweden, and highlight a number of important institutional and policy-related differences across these countries. Sections 3 and 4 give an in-depth analysis of the legal prerequisites for implementing wind power at the local level in the three Nordic countries. We pay most attention to the territorial planning procedures (Section 3), but we also briefly address the rules governing environmental permitting of new windmills as well as the role of public participation (Section 4). Finally, Section 5 provides some concluding remarks and implications.

2. Wind power development and policy in the Nordic countries

2.1. Capacity expansions and policy support

Fig. 1 displays the development of installed wind power capacity in Denmark, Norway and Sweden during the last 25–30 years, and contrasts the significant growth in Danish wind power with the much more modest developments in Norway and Sweden. The expansion in Denmark took off during the mid-1980s, while the introduction of wind power in the other two countries became noteworthy only during the late 1990s. In this section we provide a brief historical analysis of wind power development in these countries, and indicate how various policy instruments have been used to stimulate the introduction of this technology.

The above differences in wind power development for the Nordic countries can be explained by a variety of factors (e.g., electricity price, availability of domestic fuels and energy sources, etc.). Most analysts agree, though, that Sweden's low rate of wind power expansion has largely been a result of the political uncertainties surrounding the use of policy instruments in the country [6], as well as of the laws and rules that have governed the planning and permitting procedures of wind power plants [11]. Throughout the 1980s various research, development and demonstration projects were the only policy instruments in Sweden with wind power as an explicit addressee. This is in sharp contrast with Denmark where explicit production support was introduced already in the mid-1980s, while a corresponding support (the so-called environmental bonus) was implemented in Sweden as late as 1994. Moreover, although the Swedish support

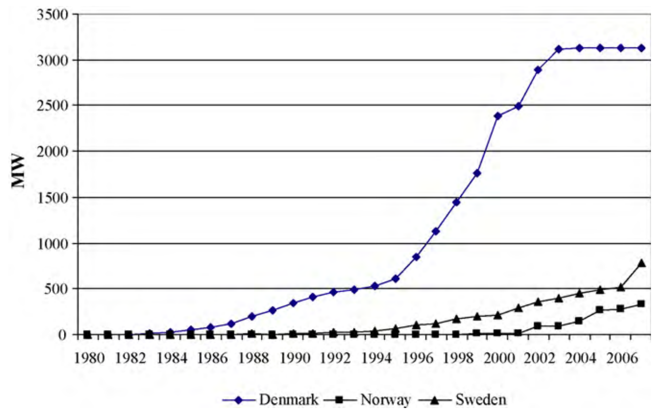


Fig. 1. Installed wind power capacity in the Nordic countries, 1980–2007 (MW) (source: International Energy Agency).

was at times relatively generous (e.g., almost US 2 cents per kWh in 2002) it was typically altered from one year to another, and thus offered investors no guarantee of sustained support over the lifetime of a wind power project. In Denmark, however, the production support during the 1990s was guaranteed by means of fixed-price contracts, so-called fixed feed-in tariffs, over a longer period (often 10 years), resulting in a more stable investment environment for wind power.

In Norway the policy interest in wind power was more or less non-existent during the 1990s. In 2003–2004, though, there existed plans to integrate a new Norwegian green certificate system with the existing certificate system in Sweden [12], but these plans were abolished a first time in 2004,[2] and instead a (temporary) investment support amounting to 25% of total investment costs was temporarily introduced. Since 2008 Norwegian wind power developers are instead provided a fixed feed-in tariff of about US 1 cent per kWh over a 15-year-period. This financial support is however lowered if the electricity price is higher than (approximately) US 5 cents per kWh. Overall the Norwegian public support to wind power is considered too low to stimulate a significant expansion in the country.

In Sweden a green certificate system for renewable energy was introduced in 2003. Its aim has been to secure a pre-determined market share for renewable electric power sources, and promote a cost-effective competition between the different types of renewable energy sources [13]. The new system has replaced previous investment subsidy programs, and has provided a decent financial support of around US 2–3 cents per kWh. The certificate price varies over time, and since 2006 the producers of renewable electricity can issue new certificates over a time period of 15 years. The green certificate scheme in Sweden has been a key behind the expansion of wind power in the country since 2006 [14].

The relatively modest development of Danish wind power during the last decade can be explained by the fact that the generous feed-in tariffs that were in place during the 1990s were replaced by a lower financial support for new onshore projects. Denmark has since 2004 supported onshore wind power production by a modest US 1.5 cents per kWh. This support is guaranteed over a 20-year-period, but it becomes zero if the conventional electricity price is roughly US 5 cents per kWh or higher. Danish energy policy has instead begun to pay more and more attention to offshore wind power development, and since 2004 there exists a tendering system for offshore installations [15]. The companies that win the opening bid are guaranteed a fixed amount – in effect a feed-in tariff – for a future production equivalent to 50 000 full load hours (in practice a support lapsing over a 12-year-time period) [16]. An important feature of the Danish offshore tendering system is that the sites have been pre-selected by the Danish government.[3]

Previous studies (e.g. [3,17]) reveal that the differences in wind power outcomes across countries can only partially be understood as a result of variations in the size and/or design of the financial support schemes introduced. Before proceeding with an analysis of the legal provisions for wind power development it is therefore useful to also comment on some important historical and institutional differences among the three Nordic countries studied in this paper. As was noted in the introduction to this paper, the promotion of wind power requires national polices while implementation typically is a local concern. For this reason we highlight the historical role and overall significance of state intervention and local power in the Nordic electricity systems.

2.2. Institutional and historical perspectives on Nordic wind power development

In the next section we illustrate that overall the different frameworks of rules governing the wind power planning process in Sweden, Norway and Denmark are seemingly comparable. All three systems are decentralized in terms of far-reaching distribution of competence and several planning levels. Nevertheless, some important differences can be found in the implementation process; the Swedish system and its 'municipal planning monopoly' often lacks confidence for a broad implementation of wind power, and leaves substantial room for discretion and for de facto ignoring national (and indeed global) energy policy objectives. It is also less precise regarding the content of the rules as well as the legal application, while the Danish planning system and in part the Norwegian system both offer a better potential for the local implementation of national goals (see also Section 3). The Swedish municipal planning monopoly has a long historical tradition, which dates back at least 100 years. Over time it has also been gradually strengthened, not the least with the implementation of the so-called Planning and Building Act in 1987.

A number of related institutional attributes have also had important implications for the historical development of the electric power systems in the Nordic countries. The Danish electricity system has largely been organized in a bottom-up manner with cooperative organizations and municipalities as owners of distribution utilities and power stations [18]. In contrast, the Swedish and Norwegian electricity regimes have been significantly more hierarchical. In the latter countries national State Power Boards (Vattenfall and Statkraft, respectively) have exercised significant control over the grid and the power generation sector, although this involvement has been less prevalent in Norway due to a more widespread distribution of hydropower stations (see also below). Moreover, in Sweden there is a relative lack of historical experience of extensive investment activities in (comparatively) small-scale power plants, and the past has instead been dominated by large state-supported hydropower and nuclear energy projects [19]. By contrast, in Denmark a lack of domestic energy resources has created natural conditions for a decentralized organization of the electric power system [18]. This means that the Danish power sector has become less associated with large-scale projects and highly expert-dependent institutions, and it is instead characterized by a stronger element of

[2] In 2008 the plans for a joint Swedish–Norwegian green certificate scheme were in part brought up again by the two governments, but so far no detailed proposal has been presented.

[3] The Danes have also designed a streamlined permitting process for these offshore projects. The Danish Energy Authority acts as a one-stop shop for environmental assessment and licensing procedures [16]. However, in this paper we mainly focus on the regulations governing wind power projects onshore.

cooperative and municipal ownership. In Norway, hydropower has dominated the country's power generation sector, but in spite of this the role of direct government influence on the sector has been less prevalent compared to Sweden. Norwegian electric power production has been more local, in part due to the favourable locations of the country's hydropower sources (and the associated varied size of the water falls) but also to a long historical tradition of democratic local governance [18].

The above historical differences across the three countries are likely to have significant relevance also for contemporary investments in Nordic wind power. In the Swedish system, there is no political tradition of promoting the expansion of smaller power-generating units as is the case with wind power. In contrast, Denmark has a tradition of local ownership and decentralized production, something which in turn has enabled a high level of local acceptance towards the investments made in wind power over the past 20 years. The strong interdependence between wind power establishments on the one hand and rural and local interests on the other has in fact existed since the early 1900s, and during the Second World War research and demonstration projects on wind power were conducted in Denmark [20]. The oil crises of the 1970s – combined with a strong anti-nuclear movement – also made it possible for the Danish government to link a major promotion of wind power with clear industrial policy ambitions. A bottom-up oriented development process took off as a result, and it has since then been characterized by a fruitful cooperation between cooperative, industrial and governmental interests.

It should of course be emphasized that any differences in the Nordic countries' regulatory systems for wind power planning (as presented in Section 3 below) should not be understood as a consequence of the various conditions for electric power generation in the respective countries. However, it is probably fair to assume that the Danish – and in part Norwegian – tradition of explicitly acknowledging local interests and participation in the planning system,[4] has generated valuable experiences in light of today's focus on increased wind power development.

Finally, unlike Sweden and Norway, Denmark has also had a clear political ambition to increase wind power capacity, while, for instance, Sweden's wind power policy in the past has been characterized by soft formulations stating that wind power shall be introduced in the energy system but without explicitly stating when and how much. The current Swedish so-called planning target for wind power, 10 TWh by the year 2015, came into force as late as in 2002.[5] In 2000 the Norwegian government presented a target to produce 3 TWh of wind power before the year 2010 [7], but this will not be met with the prevailing policy support. In 2009 Norwegian wind power production was still less than 1 TWh. The strong tradition of large-scale and low-cost hydropower in Sweden and Norway, and the associated vested interests, provide a far from unimportant explanation for the difference in wind power ambitions vis-à-vis the Danish case.

3. Territorial planning regulations in the Nordic countries

In this section we discuss the different territorial planning frameworks in Denmark, Norway and Sweden, and not the least the scope that these provide for nationally promoting wind power development and ensuring efficient outcomes at the local level. The most important difference between the legal systems in the three Nordic countries concerns the role and the nature of the respective planning systems. First it should be emphasized that in Denmark the establishment of new windmills is almost without exception regulated within the legal framework of physical planning. This means, for instance, that localization issues are entirely integrated in the Danish planning system. In Norway and particularly in Sweden, other types of laws (e.g., the Swedish Environmental Code and the Norwegian Energy Act) significantly affect wind power development (see Section 4).

The Swedish physical planning system has a significant influence on the potential for a broad implementation of wind power, and, as was noted above, compared to its Nordic counterparts it stands out as the most decentralized. In principle the municipalities in Sweden must in some way assent to (i.e., plan for) the establishment of windmills at a certain location in order for the installation to actually take place. The planning process involves the balancing between different interests, and it is thus mainly a matter for the municipal authorities. The balancing principles are however vague and leave substantial room for discretion on the part of the local government. Even though the national government (represented locally by the County Administrative Boards) is obliged to reject municipal plans not taking national interests into account, it is ultimately the municipalities which decide whether or not to accept the Boards' advice. In practice the courts appear to pay a lot of attention to the municipal positions in the permitting process, especially if there is intense competition for land areas. All in all, the municipal planning monopoly in Sweden leaves substantial room for discretion and for de facto ignoring national (and indeed international) energy policy objectives [8].

Given the rather ambiguous national policy towards wind power in Sweden, this local influence has become even more accentuated. Already in 1998, a government commission noted that the attitudes of local governments towards wind power development have differed markedly, and these attitudes have in turn often determined the outcome of the planning process ([21, p. 152,22]). Moreover, Khan's [23] empirical study shows that the extent to and the way in which territorial planning requirements have been implemented in Swedish municipalities largely explain the varying outcomes. His results suggest that in municipalities where there exists a political will to promote wind power and thus to integrate efficiently the diffusion of windmills into the planning process, the planning requirements have typically been flexible and simple. Important drawbacks of this approach, however, are that it may not promote an efficient location of windmills and it tends to limit the role of citizen and stakeholder participation. While successful in the short run, such a planning approach may thus in a longer perspective create suspicion towards wind power projects. In municipalities where politicians and officials are more reluctant to actively promote wind power, the planning requirements have been stricter and citizen participation more extensive. As a result, the installed capacity of windmills is often low (although wind conditions can be very favourable).

For a potential wind power investor in Sweden the above may imply considerable uncertainties about the investment conditions. Even though the economic support to specific projects is the same (per kWh) across the entire country, the legal obstacles may in practice differ considerably across regions. Of course, the legal framework is designed to address local circumstances and as such it serves a good purpose. However, Khan's [23] study largely illustrates that observed differences between the various municipal planning requirements can to a large extent be explained by differences in the attitudes of politicians and even local officials (see also [24]). This implies that Swedish wind power often faces significant local obstacles to its implementation, and the

[4] For instance, already in 1979 it was made possible for small, private investors in Denmark to attain public economic support for windmill investments, and studies show that people who own shares in wind turbines are more likely to be positive towards wind power compared to people who are not economically involved in the wind power sector. Private investors in Sweden were granted the same possibility in 1992.

[5] This target is not a production goal; it simply implies that the Swedish planning system should *permit* 10 TWh of wind power no later than 2015.

technology's contribution to the fulfilment of national policy goals tends not to be paid enough attention.

Compared to Sweden the Danish and Norwegian planning systems both have a more hierarchical structure. In Denmark the planning system that prevailed during the most rapid expansion period for wind power in the country, comprised three authoritative levels (national, regional and municipal) and four different types of physical plans (national, regional, municipal and local).[6] The national planning authorities deal with overarching planning issues as well as the implementation of national planning objectives, whereas the regional and municipal planning authorities handle the planning of the open land and the town areas, respectively. The function of this hierarchical system is built upon two, closely related, characteristics; 'rammestyring' and 'strive for' provisions. These are of central importance as regards the prerequisites for the implementation of national planning objectives, such as increased wind power. 'Rammestyring' (framework steering) implies a framework of rules to guide individual decisions. Each level of planning provides the framework within which the lower level planning may be conducted. For instance, the regional planning authorities must respect the framework outlined by national directives (see also below), and municipal plans must comply with regional planning guidelines. Overarching planning objectives may thus be implemented through the national level plans and all the way down to the legally binding local level plans. In other words, the different plans are essentially *vertically integrated* [26], and – as a main rule – regional planning guidelines may not be contradicted by municipal or local plans. Areas designated for windmill installations in the regional plan shall be appointed for the same purpose in the municipal plan. The "rammestyring" is connected to the "strive for" provisions, the latter obliging the planning authorities to *strive to* implement the plans or planning guidelines that they have adopted when exercising authority in accordance with the Danish Planning Act [27].

A Danish wind power planning directive was issued in 1999 to secure the implementation of the national energy policy objective of reducing emissions of carbon dioxide through increased use of renewable energy resources.[7] This directive is implemented by means of regional and municipal planning, and stipulates that areas suitable for windmill establishments in terms of environmental impacts and energy efficiency should be designated and included in the regional planning guidelines. It stipulates rather detailed guidelines for the establishment of windmills, such as the distance to residential areas and a requirement to install the mills in groups. Municipal and local plans for windmill installations may only be established for areas already designated for this purpose in the regional planning guidelines. The regional planning authorities have thus had the primary responsibility for wind power planning in Denmark, including the drafting of environmental impact assessment reports. Although areas suitable for wind power purposes should be appointed in the regional plan, the directive does not oblige the planning authorities to designate areas for windmill installations. However, to ensure that areas suitable for large windmills are protected from other constructions or installations that may interfere with a *later* establishment of large windmills, a comprehensive planning to reserve such areas may be required.

In Norway there exist also three levels of planning: national, regional and municipal. In contrast to the Swedish system – and much more in line with the Danish one – Norway has a vertically integrated planning system. In other words, there exists a national planning level which sets out general planning objectives that the minister should strive to implement at the regional and municipal planning levels. The Norwegian government has also laid down guidelines for the planning and location of windmill installations. These are not legally binding, but even so they do facilitate compliance with the national objectives. The level of detail concerning the nature of the conflicts that may arise as a result of the installations, and ways to solve conflicts, etc., combined with the fact that NVE – the number-one permit authority in Norway – actively promotes these guidelines, supports this conclusion.

Similar to the Danish case, areas for windmill exploitation in Norway are assigned in the regional plans, based on, among other things, wind resources, the presence of opposite interests, etc. The regional plans should then "provide direction" for the municipal as well as the national planning, and they function thus as a link between the latter levels of planning, both in terms of objectives and actual implementation. The above points towards a more binding planning system than in Sweden, the latter essentially lacking any type of regional planning (or at least it does *de facto* not carry any enforcement mechanisms). It is also worth noting that in Norway it is possible for private actors to work out proposals for detail plans and then present these to the planning authority. In view of the fact that one of the problems with the Swedish system is the detail plan requirement in connection with the municipalities' exclusive authority to set up such plans, this opportunity may be important. Even if the municipality has the last say on the matter of detail plans also in Norway, it is presumably more difficult to turn down a proposal than it is to decide not to set up a plan in the first place.

On an overall level the different frameworks of rules governing the wind power planning process are seemingly comparable in Sweden, Denmark and Norway. All three systems are decentralized in terms of far-reaching distribution of competence among several planning levels. Nevertheless, there are some important differences in the implementation process, and ultimately in the possibility to make national policy work at the local level. The Danish 'rammestyring', in combination with the option to adopt partly mandatory planning directives, implies that national level policy objectives may not be overlooked either in the planning process or in the implementation of an adopted plan. A similar – vertically integrated – system exists in Norway, and this tends also to facilitate wind power development. One piece of evidence in support of this conclusion is that landscape protection organizations in Norway have lobbied for a planning system with more discretionary power to the municipalities, but NVE has resisted such a change on the grounds that it would hamper future investment activities in the wind power sector. The experiences from Sweden show in turn that the strong municipal position leaves substantial room for discretion and for *de facto* ignoring national policy objectives.

4. Environmental concession and public participation

In this section we briefly comment on the systems of rules governing the assessment of the environmental impacts of wind power installations. Since the establishment of new windmills in Denmark is almost without exception regulated within the legal framework of physical planning, our focus in this section lies on the differences between the Norwegian and the Swedish legal frameworks.

In Sweden the rules on physical planning represent essentially only one out of two major components in the relevant legal

[6] In 2007 the Danish planning system was partly reformed with a slightly different role for the regional planning level (e.g. [11,25]). However, the most central mechanisms governing the establishment of wind power have remained more or less unaltered.

[7] Cirkulære om planlægning for og landzonetilladelse til opstilling af vindmøller (vindmøllecirkulæret). CIR no. 100, 10/06/1999 (LBK No. 763, 11/09/2002). *Directive on planning and land zone permission for the establishment of wind turbines.*

process. The second component is the Environmental Code, which states that large- and medium-sized wind power stations can only be permitted if they are in compliance with certain environmental requirements. These include the basic and special resource management provisions as well as the so-called localization requirement. The basic resource management provisions include general provisions for the weighting between different land-use interests, but also legal "protection" for areas related to certain public interests (e.g., areas particularly suitable for energy production). The weighting provisions are however vaguely formulated, and therefore provide substantial scope for different interpretations regarding the legal application. Wherever possible, the legally protected areas should be protected against activities that may *significantly affect or damage* the character of an area or are *prejudicial* (i.e., constraining) to its use. In practice, this protection is however relatively weak, not the least since areas may be "suitable" for more than one purpose. At best, areas may be designated as "national interests" for wind power production, implying that the areas *shall* be protected against (in this case) *prejudicial* activities. Still, if an area is of national interest also for other purposes (e.g., nature conservation), the legal rules provide very little guidance and leave the decision-makers with substantial discretion. Analyses of Swedish case law confirm that the prerequisites for wind power development provided by the basic resource management provisions are unpredictable both regarding the possibilities to avert obstructive activities as well as to explicitly promote wind power [8,11].

The Swedish Environmental Code also outlines *special* resource management provisions. These protect geographically delineated areas from exploitation and environmental interferences due to their natural and cultural values. Such an area is *in its entirety* of national interest, which implies that the weighting has already been made and that, in a competitive situation, precedence should be given to the protected interests. Windmills can only be developed in these types of areas if they *meet no hindrance* by the area provisions and do not *significantly damage* the protected values. Overall, however, experiences from case law show that these provisions leave the authorities with significant discretionary power [11]. It therefore becomes difficult to foresee to what extent windmills will be granted permission, and this vagueness adds to the economic uncertainties faced by investors.

Windmill development in Sweden is also subject to the so-called localization rule, under which requirements regarding the selection of sites can be brought upon operators. Similar localization requirements do not exist in Norway and Denmark, and in Sweden it has occasionally provided an important obstacle to windmill development in Sweden on several occasions. Two issues are of particular concern. First, for permanent activities, the selected site must be suitable with regard to the objectives of the Environmental Code and the resource management provisions. Second, for *all* activities, sites must be selected so that the purpose of the activity is achieved with "a minimum of damage or detriment to the environment". In controversial cases, the latter requirement obliges the operator to undertake an objective assessment of alternative sites. This may in some cases imply a very stringent – and even inefficient – obstacle towards installation. The windmill owner may not have access to any other site than the chosen one, but if another site is found to better achieve the purpose of the activity from an environmental point of view, a permit cannot be issued unless the costs for altering the location are found unreasonable.

The legal process for wind power permitting in Norway has overall a larger resemblance to the Danish system, i.e., it relies heavily on the planning system to deal with localization issues. Still, there are also complementing laws such as the Norwegian Energy Act of 1991, which, for instance, sets out the rules for o-called installation and area concessions. The installation concession is granted for a specific construction, e.g., a windmill or an entire wind farm. Area concessions on the other hand are based on the division of the Norwegian territory into network-cooperation areas [11].

As a part of Norwegian wind power development, a proposal for guidelines for the planning and location of windmill installations has been developed by the Ministry of environment.[8] These guidelines were developed in view of the fact that an extensive development of wind power claims access to rather large land and/or water areas, which may stir up conflicts between different interests. The overarching objective of the guidelines is thus to ensure that the development of wind power comes about in interplay with other important social interests. In addition, the guidelines also aim to make the planning and permitting processes more efficient and the outcomes more predictable. The guidelines, which are not legally binding, are generally formulated and meant to serve as a basis for, among other things, the concession assessments in keeping with the Energy Act. The final – and decisive – assessment is however made by the concession authority, in this case the Norwegian Water Resources and Energy Directorate (NVE). Overall the more precise regulations and specified prerequisites in the Danish laws and bylaws as well as the Norwegian guidelines leave the administrative authorities in these countries with less room for discretion than is typically the case in Sweden.

The different legislations in all three Nordic countries provide for – and encourage – stakeholders to participate in the decision-making process, but particularly in Sweden and Norway local environmental opposition has been a major obstacle against wind power development (e.g. [28]). This problem is accentuated by the sometimes extensive appeal possibilities (at least in Sweden), and by the overlap of the permit and planning systems. Our analysis of Danish case law (e.g. [11]) also suggests that in order to voice any negative attitudes towards planned windmill projects it is important to get involved early in the decision-making process, while it is easier in Sweden to prevent the installation of windmills at later stages. The reason for this is that the Danish system relies more extensively on pre-determined standards such as noise emission limits, while the Swedish legislation only offers very vague guidelines for how different opposing interests should be assessed. The legal rules in Sweden thus open up for "negotiations", court rulings, etc., and therefore generate stronger incentives to appeal since the prospects for successfully hampering wind power projects are greater than the corresponding prospects in Denmark. Moreover, since the only formally binding legal source – the legal text – does not in any precise way outline how to value and balance the interests involved, it is often inevitable that stakeholders' attitudes gain significant weight in the Swedish courts' decisions.

For the above reasons the average lead times for wind power project developers are overall higher in Sweden compared to both Norway and Denmark [9],[9] and the principal administrative cause of delay is typically linked to the territorial planning provisions. In Europe average lead times for wind power projects range between

[8] Retningslinjer for planlegging og lokalisering av vindkraftanlegg. *Høringsutkast*. Miljøverndepartementet avdeling for regional planlegging 19 oktober 2006.

[9] Assume, for instance, that a large Swedish windmill is projected offshore close to a city. The Planning and Building Act would normally require a detailed plan and a separate building permit [11]. According to the Environmental Code two permits are needed, one since the windmill constitutes a (potential) "environmentally hazardous activity" and another since it represents a "water activity". Each of the permitting processes provide for stakeholder participation and for appeals in two additional instances. Although the different permitting procedures are sometimes coordinated, it is obvious that the overall planning and permitting process may take several years, in some cases more than five, particularly in those cases where strong negative attitudes are expressed among relevant stakeholders.

1.5 and 4.5 years [29], while they may often exceed 5 years in Sweden and typically range between 2 and 4 years in Norway [30]. The reasons for the shorter observed lead times for wind power in Norway include both the above-mentioned guidelines for the planning and location of windmills, but also the fact that Norwegian authorities are expected to comply with time limits in preparing decisions on concession.

In the Nordic countries the problem for wind power projects is often not so much that projects in the end are denied the necessary permits; instead the problem is related to the fact that long lead times imply increased uncertainty about the project revenues and costs that will emerge as the process extends over time (not the least since the revenues largely are policy-determined). This may result in a higher rate-of-return requirement on the part of the investor, and the competitiveness of wind power is strongly dependent on this requirement. The latter is due to the fact that the capital costs involved in wind power development form a sizeable part of the total lifetime cost of a typical project, and the higher the uncertainties about the future rate-of-return on the investment are, the less competitive wind power will become. For instance, both bio- and gas-fuelled power are in this sense less capital-intensive (e.g. [14]), and will thus benefit from increased uncertainties about market and policy developments.

5. Concluding remarks and implications

The analysis in this paper has addressed some important institutional and legal differences in wind power planning and permitting across three Nordic countries. The results illustrate that the strength and the design of the different public support schemes for wind power can only to a limited extent explain important inter-country differences in national wind power capacity levels. An important conclusion is that in comparison to Sweden the physical planning systems in Denmark and Norway all provide greater scope for implementing a national wind power policy at the local level. For instance, the Danish planning system is vertically integrated, and involves a designation of areas for wind power purposes in the local plans. The Norwegian system is also vertically integrated in the sense that the national plans identify goals and guidelines, which should be implemented at the regional and local levels. The Norwegian government has also developed fairly detailed guidelines for the planning and localization of wind power plants, not the least for how conflicts of interest should be managed. These guidelines are not legally binding, but from the perspective of investors they facilitate the legal compliance process. In Sweden only very vague guidelines are provided in specific cases, and in principle the municipalities in Sweden must in some way assent to (i.e., plan for) the establishment of windmills at a certain location in order for the installation to actually take place. The municipal planning monopoly in Sweden thus leaves substantial scope for local discretion and for de facto ignoring national energy policy objectives.

The above implies that the Swedish planning system tends to promote a cost-ineffective diffusion of wind power in the country. This is due to the facts that: (a) the local planning monopoly tends to give a high priority to local impacts (e.g., visual interference) while giving less weight to, for instance, wind conditions, low-costs for grid connection, etc.; (b) the so-called localization rule in the Swedish Environmental Code may promote localizations that minimize environmental impacts rather than the overall social net benefits of the project; and (c) small-scale investors (e.g., farmers, cooperatives, etc.) may lack the patience and the resources needed to endure an extended licensing procedure even though they, for instance, own land where the economic conditions for wind power are very favourable.

The above suggests that although public support to wind power may be necessary to promote its diffusion, the introduction of new policy instruments or the modification of existing ones should generally be preceded by an evaluation of the legal and institutional framework governing wind power development. The same policy instrument – in terms of both size and design – can induce significantly different developments depending on the legal preconditions for the location and environmental assessment of windmills. The success and failure stories of technology support policies can thus not easily be transferred across country borders, and it is important to understand the way in which the incentives created by these support schemes are 'filtered down' from the national level to implementation at the local level. This likely goes for other new energy technologies as well; the institutional frameworks governing their gradual diffusion may be fundamentally different when compared across countries.

Finally, energy and climate policy is largely international in scope, and in Europe there exist also long-term political aspirations to integrate the different types of national support systems for renewable electricity sources (e.g. [12,31]). The presence of significant differences in planning procedures for renewable energy projects may, however, create tensions since stringent conditions in one country will increase the joint, aggregate cost of attaining, for instance, the EU target for the share of renewable energy sources. The benefits of energy and climate policy (e.g., improved security-of-supply, reduced carbon dioxide emissions, etc.) are largely international in scope, but the costs of implementation are typically borne at the local level. This fact may act as an impediment to increased international integration, but it may equally well put pressure on countries to reform local planning and permitting strategies. The analysis of the future prospects for each of these two outcomes ought to provide an important area for further research in renewable energy policy.

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